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(54) AN INDICATOR DEVICE FOR CONTINUOUSLY INDICATING A BRAKE CIRCUIT FAILURE IN HYDRAULIC DUAL-CIRCUIT BRAKE INSTALLATIONS IN VEHICLES, MORE PARTICULARLY MOTOR VEHICLES

(71) WE VEB BREMSHYDRAULIK LIMBACH-OBERFROHNA, of 17 Oststrasse, DDR 9102 Limbach-Oberfrohna, German Democratic Republic, a Corporation organised under the laws of the German Democratic Republic, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to an indicator device for continuously indicating the failure of brake circuits in hydraulic dual-circuit brake installations for vehicles, more particularly motor vehicles, which signals continuously the failure of a brake circuit to the driver.

A pressure balancing or equalisation device for a dual-circuit brake installation is known according to German Patents 526 588 and 558 036, which comprises a single cylinder having a piston, the ends of which cylinder are provided with stops limiting the piston stroke and are connected on both sides of the pressure equalisation piston to a brake pressure pipe system, the piston subdividing the cylinder into two pressure chambers. The disadvantage of this pressure equalisation device is that although when a brake circuit becomes leaky it is sealed by the sliding of the piston, nevertheless after repairs this device must be opened in order to restore the piston into its central position, and secondly no indication is given to the vehicle driver through the intermediary of a monitor lamp or the like. The failure can only be detected by a driver's experience, that is the pressure equalisation device lacks two essential technical features, namely the indication, more particularly a continuous indication, of a brake circuit failure, and secondly the automatic return of the piston into the initial position.

An alarm device for a motor vehicle dual-circuit brake installation is further known according to German Patent 1 605 881, wherein the device likewise comprises a single cylinder and a piston located therein, which again divides the cylinder into two pressure chambers. The piston which is

slidable in the cylinder in its longitudinal direction, is maintained in the central position by pre-stressed springs. The pre-stressed springs are each in abutment by one end against the cylinder housing and by the other end against the piston. A resiliently pre-stressed switch pin maintains the piston in the circuit failure indicating position that is the pressure of the switch pin must be stronger than the force of the pre-stressed spring so that a continuous circuit failure indication is ensured. This has the result that increased wear occurs due to the pressure on the switch pin and on the piston. There is an increased risk of the switch pin shearing off, or at least of its becoming bent by the relatively steep control cams of the piston.

Way-valves according to TGL 10 931 are also known from "Fachgebiet Hydraulik" (German Democratic Republic Handbook of Standard Hydraulics and Pneumatics, Part 2, Special Edition 1965), of which a floatingly arranged valve piston is maintained in a central position by means of two pre-stressed centring springs. Said centring springs are arranged on both sides of the piston, each between a fixed and a longitudinally slidable stop, so that the piston always returns into its initial or central position. But when the piston is displaced, the opposite pre-stressed centring spring exerts no additional force upon the piston, because it is in abutment through the sliding stop with a fixed stop edge.

It is a disadvantage that these way-valves can only be used in hydraulic control units.

Alarm and indicator devices are also known according to German Patents 1 655 279 and 1 655 280, of which the floatingly arranged piston is likewise maintained in the central position by two pre-stressed centring springs, the said centring springs being each arranged between a fixed and a longitudinally slidable stop.

The disadvantage of these devices is the lack of a continuous circuit failure signal. Furthermore, the production of the piston and also of the longitudinally slidable and fixed stops of the centring springs is comparatively complicated technologically.

An alarm and indicator device is also known according to German Patent 1 655 538 for a hydraulically operated dual-circuit brake installation, the piston of which with a

5 central control groove is arranged to move freely axially in two hollow pistons against a pre-stressed spring at each end of the piston.

The disadvantage of such device is that even small pressure differentials between the pressure chambers on both sides cause the piston provided with a central control groove to move out of its central position, so that although no fault has occurred in the individual brake circuits, a circuit failure is indicated. This occurs due to the fact that the centring springs on both sides have no stop towards the piston.

A technical solution is to be developed which indicates the failure of a brake circuit only when a defect has actually occurred, that is when a predetermined pressure differential between both circuits is exceeded and is ready to function at all times by only slight movement of the wearing parts. It should be capable of being produced in a constructionally simple manner with a small technological outlay. On the other hand, this solution should achieve a permanent failure indication even when the brake or brake pedal is not actuated, and the device must return itself into the initial position without any extraneous intervention.

The aim of the invention is to develop a device for indicating a circuit failure in hydraulic dual-circuit brake installations which becomes operative only when a hydraulic pressure differential between the two circuits which cancels the pre-stressing force of the centring springs on both sides is exceeded. This device should be so constructed that a permanent indication of the circuit failure is ensured even if the brake is not actuated, that is even if the piston has been moved back into its central position by the two centring springs after the completion of the braking operation.

Accordingly, the present invention consists in an indicator device for continuously indicating the failure of a brake circuit in hydraulic dual-circuit brake installations of vehicles, more particularly motor vehicles, characterised by the combination of the following features:

- a) A piston constructed as a switching signal transmitter mounted floating in a cylinder and dividing the cylinder into two pressure chambers.
- b) Two pre-stressed centring springs each arranged between a fixed abutment edge and a longitudinally movable abutment disc and maintaining the piston in its central position compensating a predetermined pressure differential.
- c) A degree of freedom of the longitudi-

nally movable abutment discs between further fixed abutment edges dictated by the parameters of a ball located in a recess of said piston.

- d) A thyristor connected to a voltage source and to an indicator lamp, the starting electrode of said thyristor being controlled by a switch member fitted on the cylinder and actuatable by the piston via the ball, and a switch pin, through a series electrical resistance.

In order that the invention may be more readily understood, reference is made to the accompanying drawing which illustrates diagrammatically and by way of example one embodiment thereof. The drawing shows a hydraulic pressure differential circuit failure indicator device with a signal transmitter and with an indicating circuit connected thereto with integrated storage function.

According to the drawing, reference numeral 1 indicates a cylinder 2 a piston slidable within the cylinder, 2a and 2b two cylindrical piston attachments 3 and 4 cylinder pressure chambers, 5 and 6 two longitudinally movable stop discs and 7 and 8 two centring springs for the piston 2. Two sealing rings 12 and 13 are carried by the piston 2 and seal it relative to the two pressure chambers 3 and 4. The piston 2 is provided with a central recess 2c in which a ball 9 is located. A pin 10 of a switch member 11 is in abutment with the ball 9. Edges 18a and 19a of closure plugs 18 and 19 constitute outer abutment surfaces of the centring springs 7 and 8 and the plugs 18 and 19 contain pressure fluid connections 14 and 15. Sealing rings 20 and 21 seal the pressure chambers 3 and 4 relative to the exterior. Abutment edges 16 and 17 limit the spring travel of the centring springs 7; 8 inwards. A resistance R is connected in series between the starting electrode (gate) of a thyristor Th and the switch member 11. An indicator lamp is designated K_L and a voltage source U_B.

The mode of operation of the device in accordance with the invention is as follows:

When a predetermined pressure prevails in both brake circuits the piston 2 occupies its central position (as shown). When a circuit failure occurs so that the predetermined pressure differential is exceeded, the piston 2 slides towards the brake circuit connection to which the failed brake circuit is connected. Thus the brake fluid not subjected to pressure escapes from the respective pressure chamber 3 or 4, and the respective centring spring 7 or 8 is compressed. The ball 9 is lifted out of the piston recess 2c and actuates the pin 10 of the switch member 11. Due to the closing of contacts in the switch member 11, electric current flows through the series resistance R and triggers the thyristor Th through its starter electrode. As soon as the thyristor Th has started, a current flows

continuously through the latter until the battery voltage of the vehicle is interrupted. It is thereby achieved that even in the case of non-actuation of the brake, the indicator lamp lights continuously and indicates the circuit failure to the vehicle driver. After completion of the braking operation, the piston 2 is moved back into its initial position by the respective centring spring 7 or 8. Slight pressure differentials in the brake circuits, such as may often occur even with an intact brake, do not lead to the sliding of the piston 2 due to the pre-stressing of the centring springs 7 and 8. The stop discs 5 and 6 also prevent the compression spring present in the respective non-defective brake circuit from exerting an additional force upon the piston.

In order to achieve long service life of the existing wearing parts, but more particularly of the seals 12, 13, the switching stroke of the piston 2 should be kept as short as possible. The degree of freedom of the longitudinally movable stop disc 5; 6 is therefore approximately equal to the radius of the ball 9. This produces an overall switching stroke to both sides approximately equal to the diameter of the ball 9 for the piston 2 and hence for the seals 12; 13. Consequently the recess 2c is also dimensioned according to the diameter of the ball 9, that is its length corresponds approximately to the ball diameter.

WHAT WE CLAIM IS:—

1. An indicator device for continuously indicating the failure of a brake circuit in hydraulic dual-circuit brake installations of vehicles, more particularly motor vehicles, characterised by the combination of the following features:

- a) A piston constructed as a switching signal transmitter mounted floating in a cylinder and dividing the cylinder into two pressure chambers.
- b) Two pre-stressed centring springs each arranged between a fixed abutment edge and a longitudinally movable abutment disc and maintaining the piston in its central position compensating a predetermined pressure differential.
- c) A degree of freedom of the longitudinally movable abutment disc between further fixed abutment edges dictated by the parameters of a ball located in a recess of said piston.
- d) A thyristor connected to a voltage source and to an indicator lamp, the starting electrode of said thyristor being controlled by a switch member fitted on the cylinder and actuable by the piston via the ball, and a switch pin, through a series electrical resistance.

2. An indicator device according to claim 1, wherein the prescribed degree of freedom

of the longitudinally movable abutment discs is approximately equal to the radius of the ball.

3. An indicator device according to claim 1, wherein the length of the piston recess is substantially equal to the diameter of the ball.

4. An indicator device for continuously indicating the failure of a brake circuit in hydraulic dual-circuit brake installations of vehicles, substantially as herein described with reference to and as shown in the accompanying drawing.

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COMPLETE SPECIFICATION

1 SHEET

This drawing is a reproduction of
the Original on a reduced scale

